CLAIMS

What is claimed is:

1. A microfluidic device comprising:

a body having:

a first fluid passage;

a second fluid passage;

a membrane positioned separating the first fluid passage from the second fluid passage and in communication with the first fluid passage and the second fluid passage;

a first electrode positioned in the first fluid passage; and

a second electrode positioned in the second fluid passage wherein a potential applied to the first and second electrodes passes electrons from the first fluid passage to the second fluid passage through the membrane.

2. The device of claim 1 , wherein the body is polymethylsiloxane material (PDMS).

3. The device of claim 1, wherein the membrane is a gel made of agarose.

4. The device of claim 1, wherein the membrane is a semipermeable membrane made of regenerated cellulose.

5. The device of claim 1, wherein the first fluid passage includes one or more first reservoirs and the first electrode is positioned in one of the first reservoirs.

6. The device of claim 1, wherein the second fluid passage includes one or more second reservoirs and the second electrode is positioned in one of the second reservoirs

7. A method of fabricating a microfluidic device comprising:

staking three wires on a substrate, the three wires intersecting near a midpoint;

pouring polymethylsiloxane material (PDMS) over the substrate and wires;

curing the PDMS forming a replica;

extracting the center wire creating a center channel;

inserting unpolymerized gel into the center channel and curing the gel forming a gel membrane;

extracting the upper and lower wires creating upper and lower channels separated by the gel membrane in the center channel;

positioning a first electrode into the first channel; and

positioning a second electrode into the second channel.

8. The method of claim 7, further comprising:

forming one or more first reservoirs in communication with the first channel and positioning a first electrode into the first reservoir; and

forming one or more second reservoirs in communication with the second channel and positioning a second electrode into the second reservoir.

9. The method of claim 7, wherein the gel is agarose.

10. A microfluidic device comprising:

a body having a surface with a channel separating two first reservoirs;

at least one membrane in communication with the channel;

a blank covering the channel and the at least one membrane;

at least one second reservoir through the blank in contact with the at least one membrane, the at least one second reservoir in communication with the channel via the membrane;

a first electrode positioned in the channel; and

a second electrode positioned in the second reservoir wherein a potential applied to the first and second electrodes causes current to travel from the channel to the second reservoir through the membrane.

11. The device of claim 10, wherein the body is polymethylsiloxane material (PDMS).

12. The device of claim 10, wherein the at least one membrane is a gel made of agarose.

13. The device of claim 10, wherein the at least one membrane is a semipermeable membrane made of regenerated cellulose.

14. A multi-step separation device comprising:

a body having a surface with a channel separating two first reservoirs;

at least one membrane in communication with the channel;

at least two spaced apart first electrodes to maintain a first voltage in the channel, one of the first electrodes disposed in the first reservoir;

a blank covering the channel and the at least one membrane;

at least one second reservoir through the blank in contact with the at least one membrane, the at least one second reservoir in communication with the channel via the at least one membrane; and

a second electrode disposed in the at least one second reservoir to maintain a second voltage, the second voltage to cause charged particles in a solution to migrate from the channel to the at least one second reservoir through the at least one membrane.

15. The device of claim 14 wherein at least one of the first electrodes is proximate the at least one membrane intersecting the channel.

16. The device of claim 14 wherein the first electrodes are adapted to enable a voltage gradient to be applied to a solution when the solution is disposed in the channel, the voltage gradient to cause charged particles within the solution to migrate in the channel.

17. The device of claim 14, wherein the body is polymethylsiloxane material (PDMS).

18. The device of claim 14, wherein the at least one membrane is a gel made of agarose.

19. The device of claim 14, wherein the at least one membrane is a semipermeable membrane made of regenerated cellulose.

20. The device of claim 14, wherein the at least one membrane is a sieving media.

21. A method comprising:

forming a channel between two first reservoirs;

traversing the channel with at least one membrane, the at least one membranes in communication with the channel;

positioning at least two spaced apart first electrodes in the channel to maintain a first voltage, one of the first electrodes disposed in the first reservoir;

covering the channel and the membrane with a blank;

providing at least one second reservoir through the blank in contact with the at least one membrane, the at least one second reservoir in communication with the channel via the at least one membrane; and

inserting a second electrode in the at least one second reservoir to maintain a second voltage, the second voltage to cause charged particles in a solution to migrate from the channel to the at least one second reservoir through the at least one membrane.